LIGO Education & Public Outreach

Fred Raab,

LIGO Hanford Observatory, 7 Apr 08

Education and Outreach Outline: *Investing in America's Future*

- Observatory Education & Public Outreach
  - » Public and school visits to/from observatories
  - » Teacher professional development
  - » Includes national outreach component
- Summer undergraduate research program
  - » Real science exposure for STEM college students
- Visitors program
  - » Provides connections to science and education communities

Observatories are special opportunities for education

- Technical requirement to situate sophisticated science in rural areas, which happen to have large under-served populations (~45% of K-12 visitors)
- An emphasis with founding leadership, but a number of technical hurdles needed to be overcome
- Under the initial LIGO operations the core of a very successful program has been built
- Have capitalized on local targets of opportunity, so observatories have common goals but have focused early development in complementary ways

LIGO outreach programs at Observatories connect the public to LIGO science

LIGO outreach uses the excitement, grandeur and intimacy of the Observatory sites to promote science interest and science literacy among all ages. Every visitor meets the people who make the science. (“Nerds in their natural environment.”)

LIGO's education efforts are focused by our Local Educator Networks

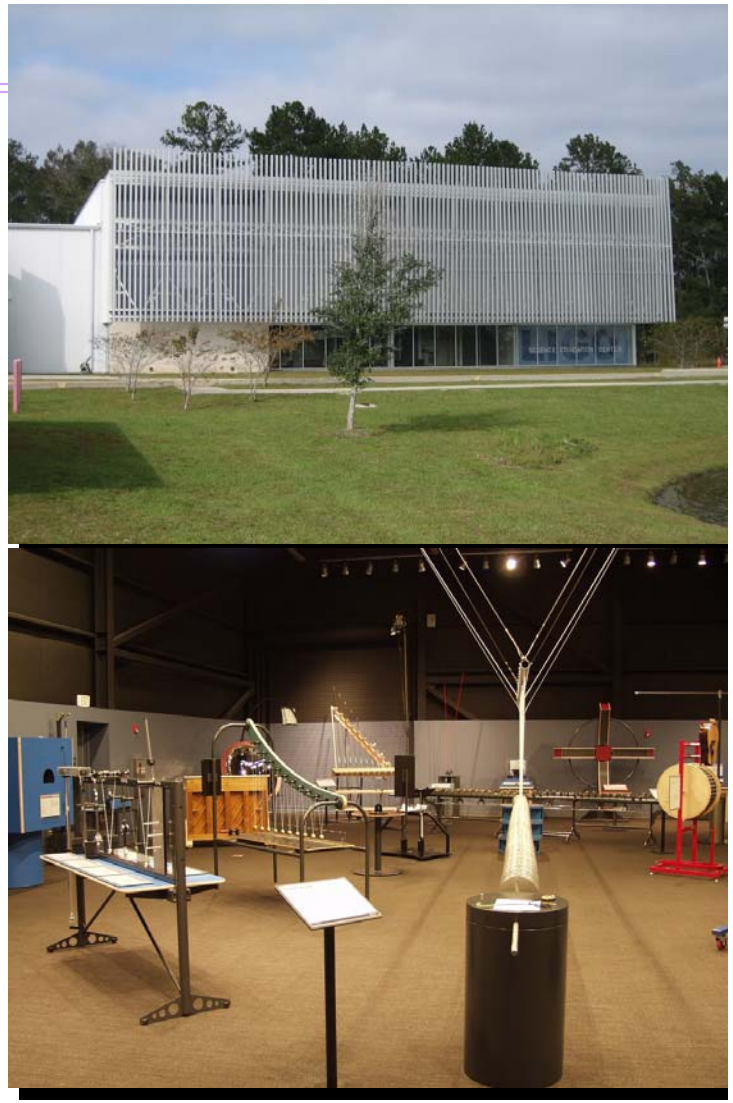
- Bring public out to "touch and see" science in the making
- Help schools with teacher training, internships and school tours
- Help us integrate science research into science teaching
- Help the public to value the richness of science

Major local outreach components include field trips, on-site public events, off-site activities and teacher professional development programs

Outreach activities engage the ethnically diverse populations that surround the Observatories

Livingston Science Education Center

- Flagship facility for LIGO EPO
- 9000 ft^2 adjacent to auditorium
- 5000 ft^2 of exhibit hall space with more than 40 exhibits
- Exhibit and classroom activities
- Programs for
  - **K-12 visits**
  - **Teacher Professional Development**
  - **Public/family outreach**
- Winner of AIA New Orleans 2007 Design Award



LIGO Science Education Center illustrates the power of partnerships

LIGO Science Education Center

Exploratorium Exhibits & Training

Docents in Training from Southern University Education Program

LA GEAR UP provides access to low performing schools

What a science education center means to rural America

- Most children in Louisiana have never met a scientist or an adult who holds a high-tech job.
- Many have never seen a place of business other than a store or (perhaps) a chemical or agricultural plant.
- In our control room, they meet an operator, a staff scientist or engineer, and perhaps visiting scientists, who tell them about LIGO and how one becomes a scientist.
- The kids step right up to the control room desk and computers and there are almost never any behavior issues; the kids ***know*** that this is the real deal, and they pay attention.
- Seeing an impressive science facility in their back yard, they can begin to think of science and engineering as part of their future, something that their neighbors do.
- We tell them to study math and science, and we hope that the programs and exhibits also nudge them in that direction.

Professional development at LSEC

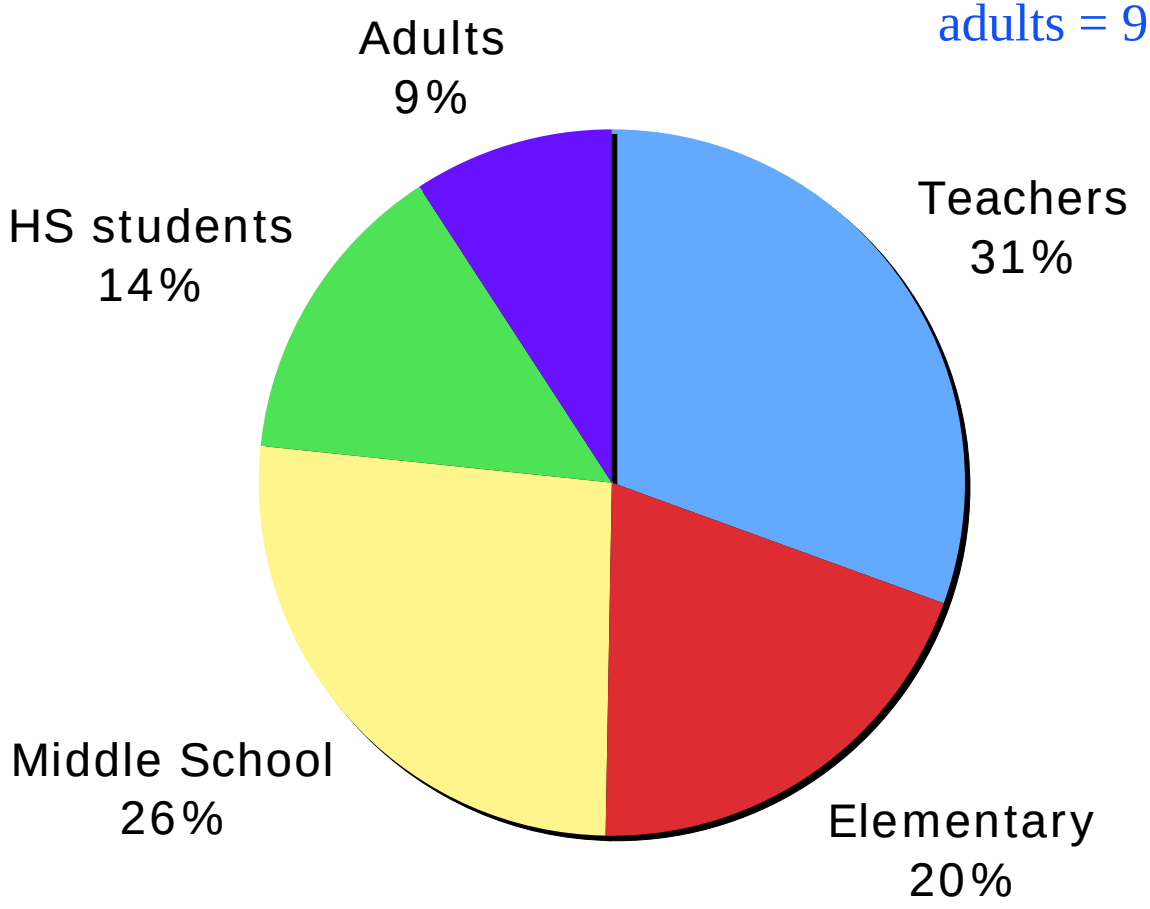
- Strengthen content knowledge and inquiry skills for in-service teachers as well as raising new generation of pre-service teachers
- Exploratorium provides not only exhibits, but training through Center for Informal Learning and Schools in use of exhibits either at a science center or in school
  - » LSEC exhibits (“full-meal deal”) have corresponding “snacks”, costing <$20 that teachers can use in school instruction
  - » Trained our education staff as trainers
- Leveraged through partner MSPs
- Over 1000 person days of in-service PD in first year after LSEC opened doors

Total Visitor Days: 4940

students = 60%

teachers = 31%

adults = 9%

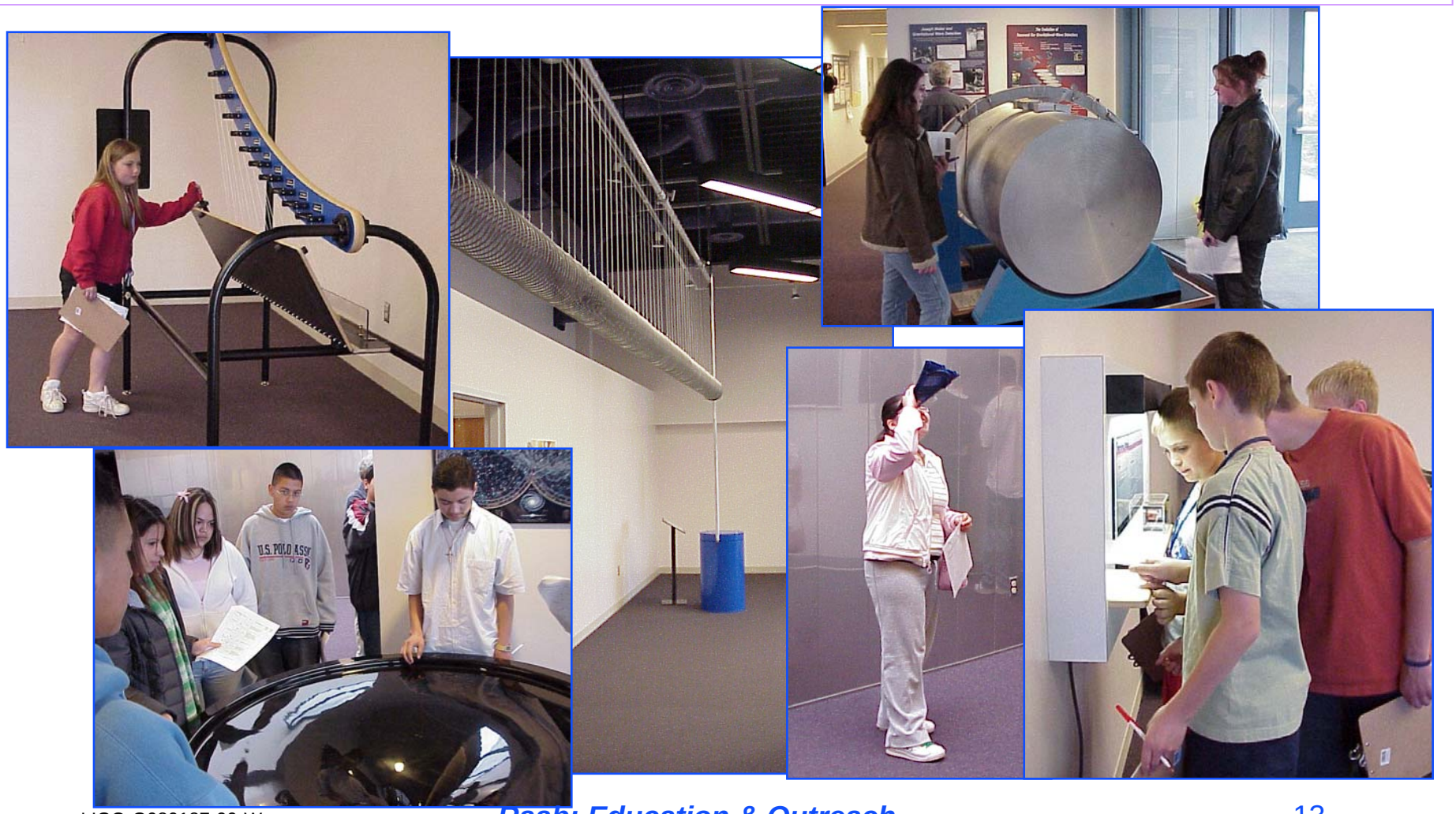


SEC Attendance 1st Year

LIGO Hanford programs also rely on partnerships to fuel growth

LHO outreach received state and local awards in 2007

Inquiry-friendly exhibits illustrate breadth of "LIGO science", tied to EALRs and GLEs



Professional development: WSU-TC T&L 571, *The Nature of Scientific Inquiry*

Going beyond "hands-on" to "minds-on" teaching

Emphasizing the Nature of Scientific Inquiry

- WSU graduate course for in-service teachers
- Intensive and immersive “summer academy” (a.k.a. “boot camp”) for science inquiry
  - » 2 weeks full day at LIGO Hanford + significant readings and papers
  - » Development of individual instruction improvement plans
- Started up using solely NSF funds; now leveraged by Math Science Partnership award to ESD123
  - » Award form WA State Office of Superintendent of Public Instruction, using US Dept. of Education funds provides strong coupling to public K-12
  - » Instructors from LIGO, WSU and Columbia Basin College with assistance from developing corps of master teachers we develop
  - » Focused on districts with high ratios of “at risk” students
  - » Focus on teachers in grade bands 4-8, opening to 3rd grade this summer
  - » Summer academy + academic-year follow-up workshops + classroom observations and coaching
  - » Professional evaluation firm + continued academic research

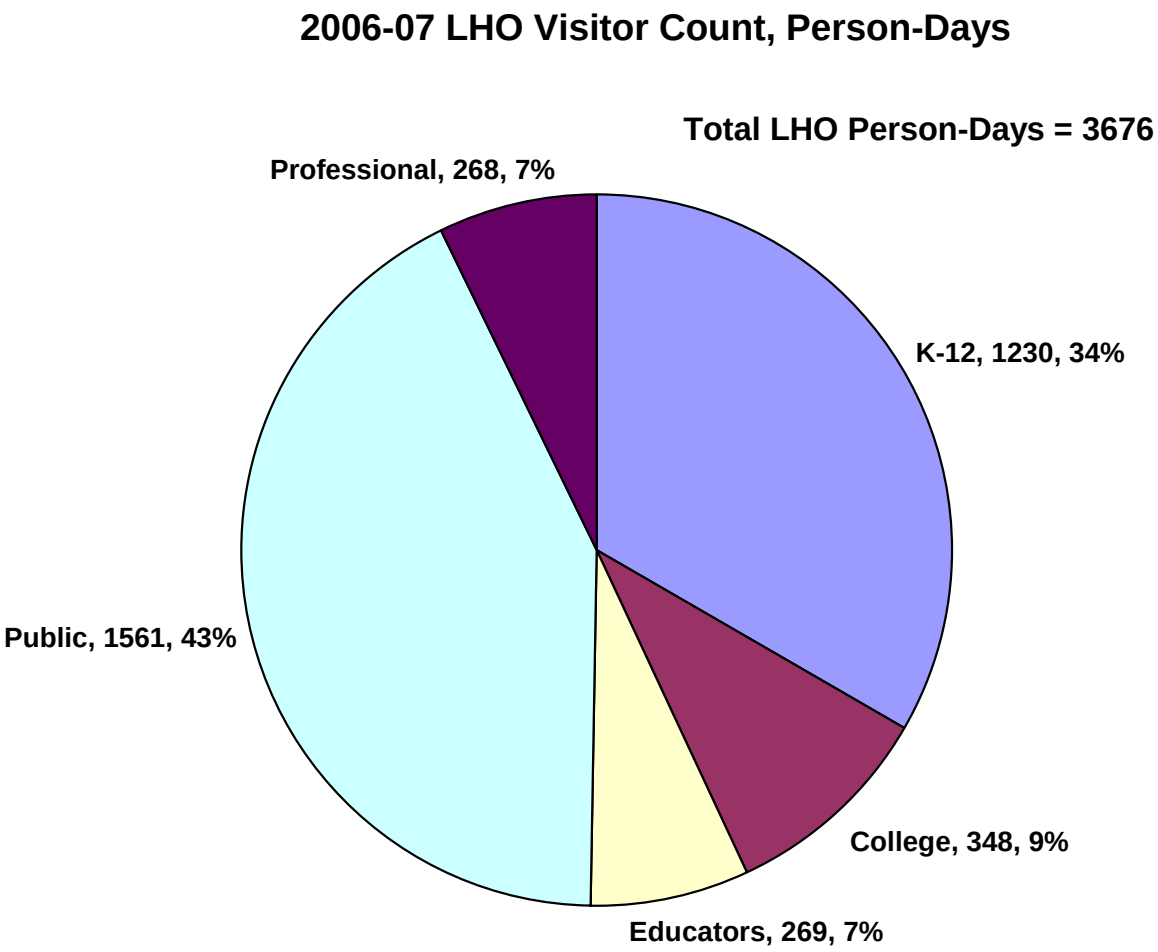
"Surrounded by Scientists" study of immersing teachers into professional science environment

Factors Influencing Elementary and Secondary Teachers' Views on The Nature of Science, (Morrison, Raab & Ingram, to appear in *Journal of Research in Science Teaching)* shows impact on teachers increases as grade level taught decreases. Teachers at these lower grade levels form first student impressions of science.

"I have learned that there is much more to developing scientific thinking than just opening a book to chapter 6, reading it, and testing for comprehension. One needs to be able to ask questions, develop investigations, formulate explanations from evidence and evaluate their explanations." (Bob, elementary school teacher, final reflections)

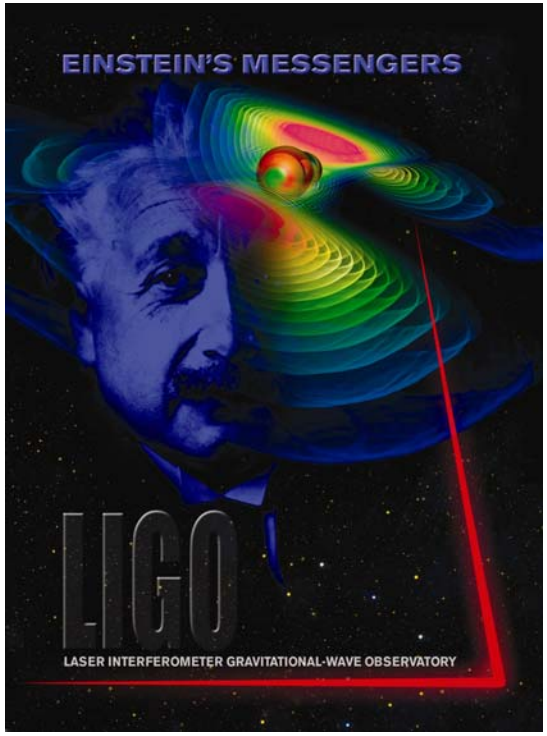
"My teaching will be affected by [scientist's] highlighting the need for the teaching of the basic underlying principles for effective science instruction. Her opinion for the need to focus on the why as opposed to the how, which is a large focus of the public education system, will enable students to build a better foundation of knowledge." (Jen, elementary school teacher, interview paper)

Hanford Observatory outreach attendance



Additional off-site activities served 4300 in the same time period.

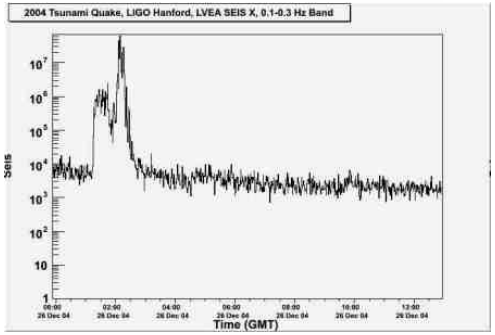
National outreach handled principally by Hanford

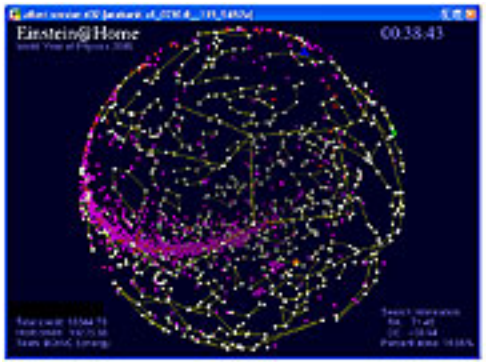


Einstein's Messengers:
Teacher support materials

PHYSICAL SCIENCES
INFORMATION TECHNOLOGY
EDUCATION
UNDERSTANDING THE UNIVERSE
Education & Outreach

I2U2 (PHY 0636265 - Fermilab): Putting LIGO environmental data into the hands of students and teachers via the Web and the Grid





Einstein@Home: An international user community

Summer Undergraduate Interns

	2002	2003	2004	2005	2006	2007
Caltech REU Site						
Caltech Students	2	0	2	0	2	0
Other Research Universities	2	5	4	5	3	4
Other Universities and Colleges	6	5	6	7	6	6
LIGO-Lab Funding						
Caltech Students	3	3	3	6	1	3
Other Research Universities	7	7	4	4	6	3
Other Universities and Colleges	6	3	5	5	2	3
International Students	9	10	5	10	2	6
Caltech + Observatories (avg 30/yr)	*35*	*33*	*28*	*37*	*22*	*25*
MIT UROP Students (subcontract)	***Average 6/yr***					

LIGO Visitor Program

- Three goals
  - » Provide visitors opportunity to learn about LIGO and develop science/education programs around LIGO
  - » Foster collaborative arrangements which further the science/education mission of LIGO
  - » Provide access by broader science/education communities to LIGO resources
- Includes both short-term and long-term visits by researchers, educators and students and travel by Lab staff to other institutions for collaborative visits
- Initially funded by separate grant + some operating funds
- Will be absorbed into regular operations

LIGO Scientific Collaboration Education and Outreach

- In addition to LIGO Lab, individual groups have many independent EPO efforts on appropriate scales
- Several exemplary efforts, for example
  - » University of Texas, Brownesville annual summer school programs in GW detector science and “physics carmival” activities
  - » Penn State development of radio programs on gravitational wave science – both English and Spanish language versions
  - » Southern University work with Timbuktu Academy and LSEC
- LSC has recently formed an E/O working group to coordinate nationally these varied outreach efforts

LIGO Academic Advisory Committee

- Formal, visible effort to ensure that professional advancement of LSC graduate students and postdoctoral scholars is promoted by collaboration
  - » Special informal bull sessions with directorate at collaboration meetings to identify needs and wants from junior members
  - » Thesis project registry to declare and protect students' academic interests in LIGO research
  - » LIGO Graduate Student Fellowship awards pay for one student to spend a year in residence at an observatory pursuing research

Summary

- Observatories, located in rural areas with special needs and under-served/represented cultural groups, provide unique opportunities for growth in an area of emphasis and concern for NSF educational goals
- LIGO has sought out partnerships to gain expertise and access to stakeholder groups
- Increasingly, LIGO is being sought out as a partner or for advice and access to potential partners
- National effort seeks broad presence in homes and classrooms
- REU and visitor programs offer growth opportunities for this new field